



NASA STTR 2008 Phase I Solicitation

T1.01 Information Technologies for Intelligent Planetary Robotics

Lead Center: ARC

Since February 2004, NASA has been actively engaged in a long-term program to explore the solar system and beyond, beginning with robotic missions to the Moon in 2008 and leading eventually to human exploration of Mars. Several NASA studies have concluded that extensive and pervasive use of intelligent robots can significantly enhance planetary exploration, particularly for surface missions that are progressively longer, more complex, and must operate with fewer ground control resources.

The objective of this subtopic is to develop information technologies that improve the capability of mobile robots to explore planetary surface. Emphasis is placed on improving automatic operations that do not require robots to operate in close, physical proximity to humans, nor human-paced interaction or continuous control.

Proposals are sought which address the following technology needs:

- Ground control user interfaces and data management systems for robotic exploration. Conventional robot command systems do not adequately address planetary surface exploration needs, particularly in terms of time-delayed and command-cycle based human-robot interaction. Proposals should focus on software tools for planning command sequences; for event summarization and notification; for interactively monitoring/replaying task execution; and/or for managing non-terrestrial geospatial information.
- Physics-based simulation to develop and test planetary rover algorithms and systems. Existing mobile robot simulators (e.g., Player-Stage) lack the fidelity required to test high (and varying) levels of rover autonomy in non-terrestrial environments. Proposals are sought that provide robot simulation frameworks with models for planetary illumination, surface composition, specialized sensor and scientific instruments, communication, and rover resources.
- Autonomous surface navigation over long-distances and in permanently shadowed regions. Novel perception techniques that utilize passive computer vision (real-time dense stereo, optical flow, etc.), active illumination, repurposed flight vehicle sensors (low light imager, star trackers, etc.), and wide-area simultaneous localization and mapping are of particular interest.
- Control of tensegrity-based structures. Structures and mechanisms built on tensegrity structures are lightweight, compact energy efficient, and robust to unexpected contacts. To date, however, tensegrity structures have received little use in exploration due to the complexity and difficulty of programmed movement. Proposals should emphasize controllers to efficiently manage position and contact forces.